

# Playing with genes

About synthetic biology, iGEM competition and our project

# Basic concepts in biology

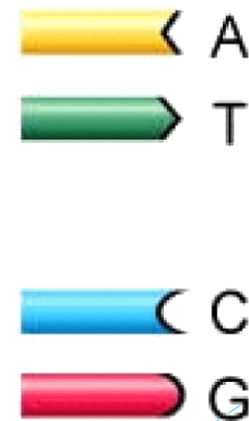
- ▶ **Biology** - branch in science concerned with the study of life and living organisms.
- ▶ **Cell** - the functional basic unit of life.  
Humans combined from billions of cells.
- ▶ **Bacteria** - one of the most ancient and common live organism on the plant.  
One bacterium in as single cell and can not be seen with naked eye.



Bacteria under microscope

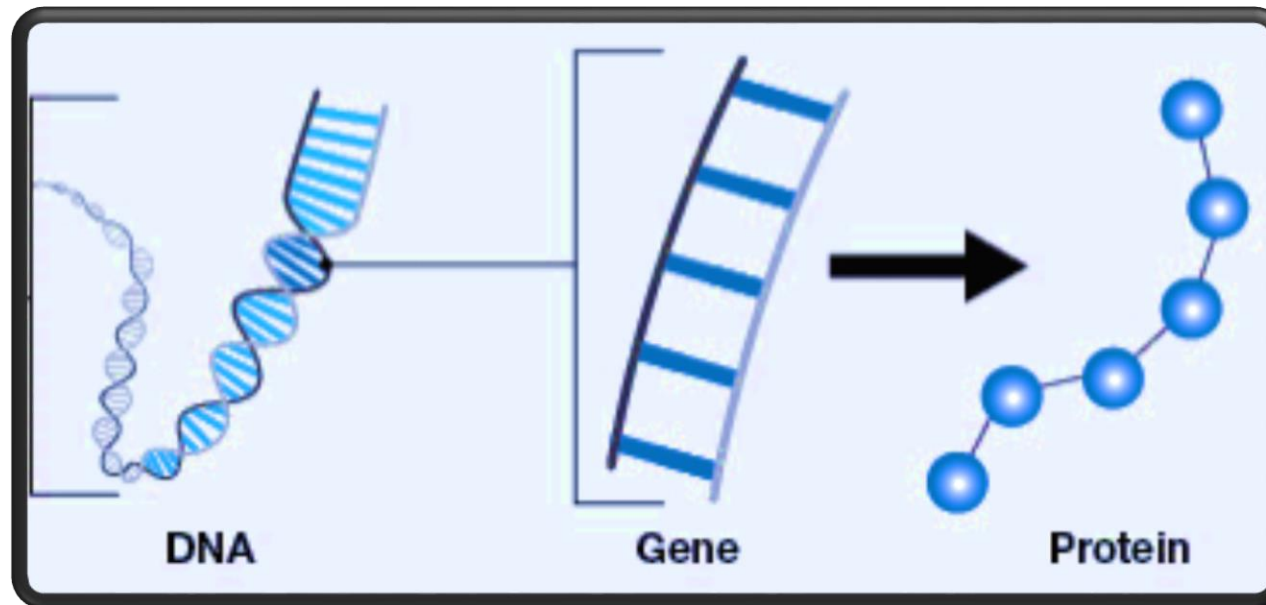
# Basic concepts in biology

- ▶ **DNA** - long molecule containing all the genetic code and the instruction to build the cell components.
  - Consists of 4 basic bricks (bases) marked as A,G,C,T
  - Different organisms diverse from each other by the sequence of the basic bricks and their number.
- ▶ **Gene** - section of DNA contains information regarding specific attribute.
  - For example: gene encodes for information about hair color.



# Basic concepts in biology

- ▶ **Protein** - the “worker” of the cell. Molecule with different activity, according to the cell needs.
  - The cell translate gene (instruction) to specific protein (worker).



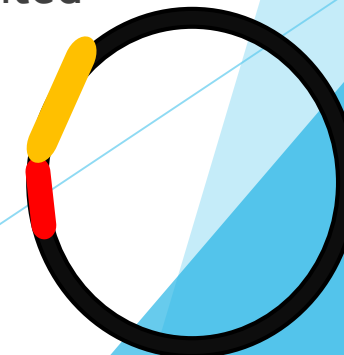
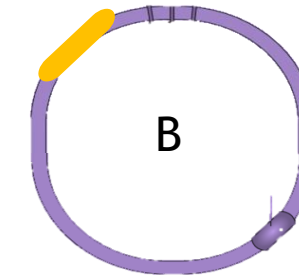
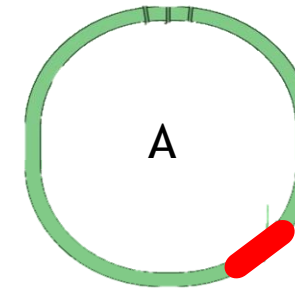
# Synthetic Biology



- ▶ **Synthetic** = unification of two units into one new unit
- ▶ **Synthetic Biology** = unification of new biology systems
- ▶ Synthetic biology is in the cross between biology and engineering
- ▶ Researcher in synthetic biology engineering new biology system based on known part from other known biology systems.

# Simple example

- ▶ Bacteria A has a gene that encodes for protein that make the bacteria color in red.
- ▶ Bacteria B has a gene that encodes for protein that make the bacteria smells like banana.
- ▶ **Goal:** get new bacteria with red color and smell like banana.
- ▶ **Process:**
  - Cut out the gene that encodes for color protein from bacteria A
  - Cut out the gene that encodes for smell protein from bacteria B
  - Take two cut genes and attach them together synthetically in the lab
  - Insert the new part into DNA of new bacteria
  - We got new bacteria with red color protein and smell protein as we wanted



# Application of synthetic biology

- ▶ Fast and cheap production of medication and vaccines
- ▶ Medication for cancer
- ▶ Detecting different materials
- ▶ Data storage
- ▶ Creating biofuel
- ▶ Biodegradable packaging
- ▶ And more...



# Funny facts

- ▶ Today you can write sequence of A,G,C,T in the computer and order DNA molecule over the internet.
- ▶ The DNA made synthetically with a machine, similar to a printer.
- ▶ Sugar is the starting material.
- ▶ With 25\$ you can buy enough amount of sugar to produce DNA of all humans on the planet!







# iGEM

## International Genetically Engineered Machine

- ▶ Worldwide synthetic biology competition.
- ▶ Participate groups of students and high school from all around the world.
- ▶ Each group build a project of biological system to solve a problem they encounter.
- ▶ Start in 2003 as MIT course with 5 groups.
- ▶ In 2016 will participate more then 300 groups from 5 continents.



# iGEM in Israel

- ▶ Groups from Israel this year:
  - Technion
  - Ben Gurion University
  - Tel Hai academy
  - Danciger high school in Qiryat Shmona
- ▶ First Israeli group was from the Technion and participate in 2012
- ▶ All three iGEM Technion so far won gold medal!



# S.Tar

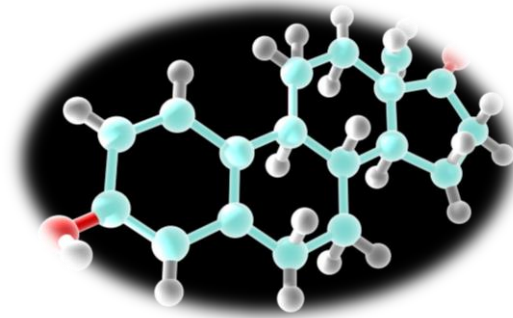
Platform for precise, fast, easy and cheap detection of specific materials



Water pollution



Forensics



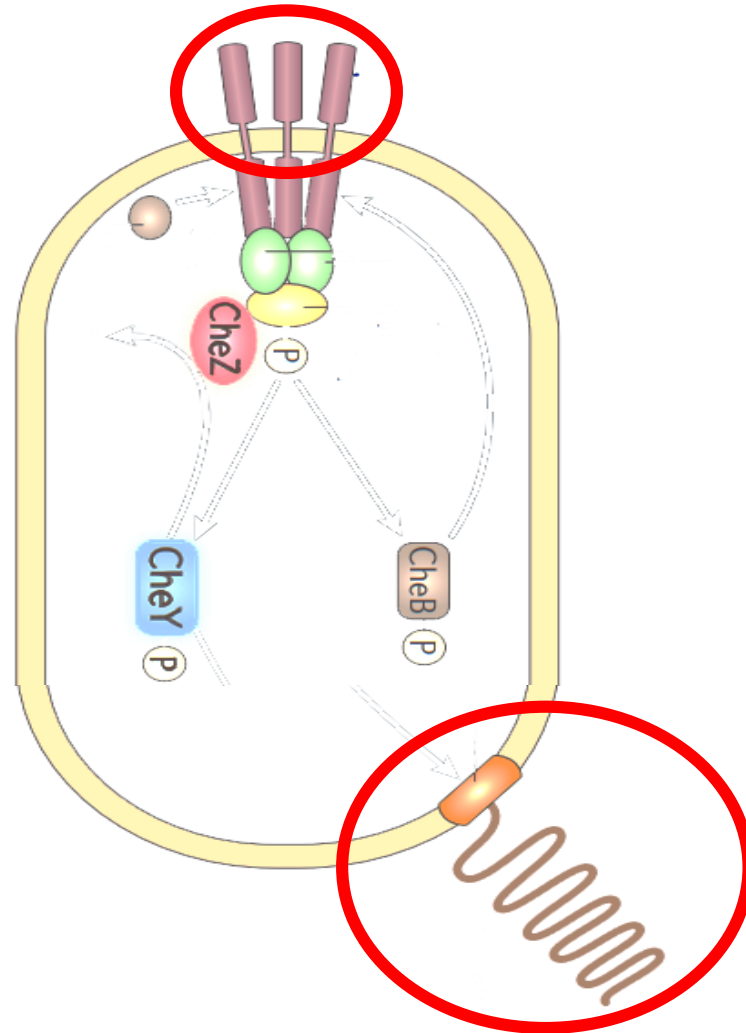
Hormones

# chemotaxis

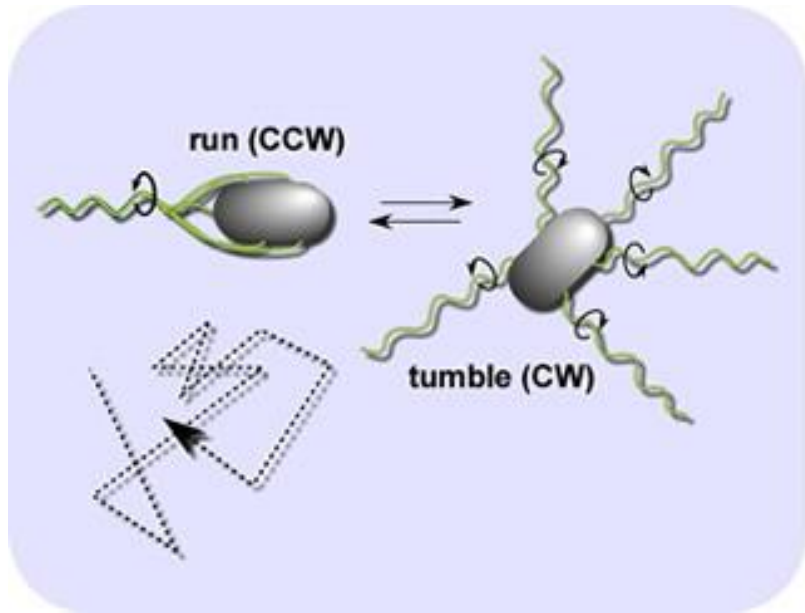
The ability of bacteria to **identify** and **move** towards attractants or away from repellents

# Identify

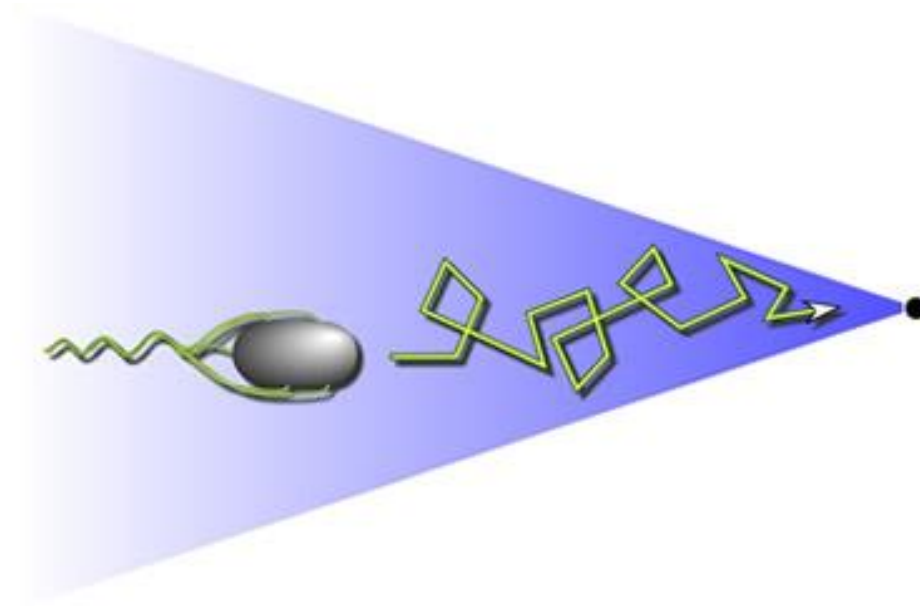
Identification through receptors



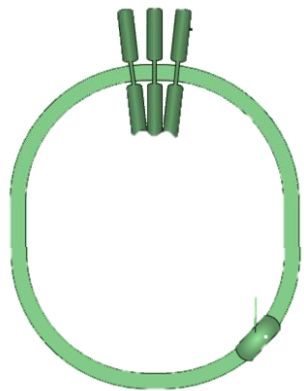
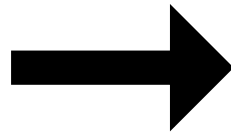
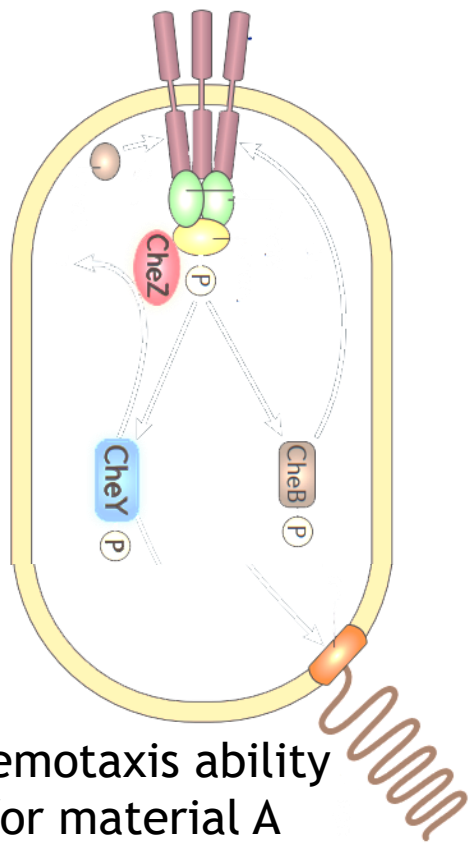
# Movement



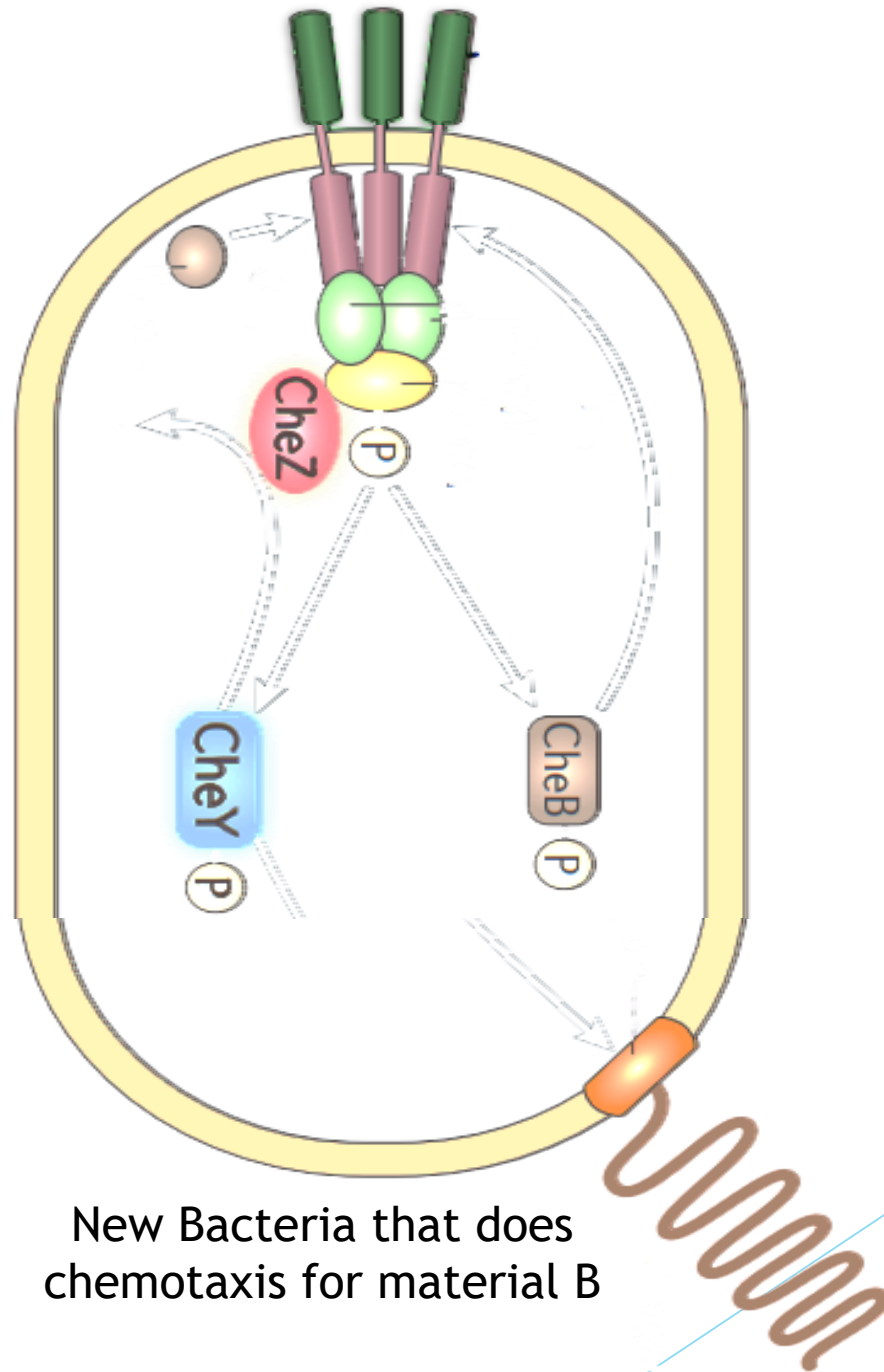
Random movement



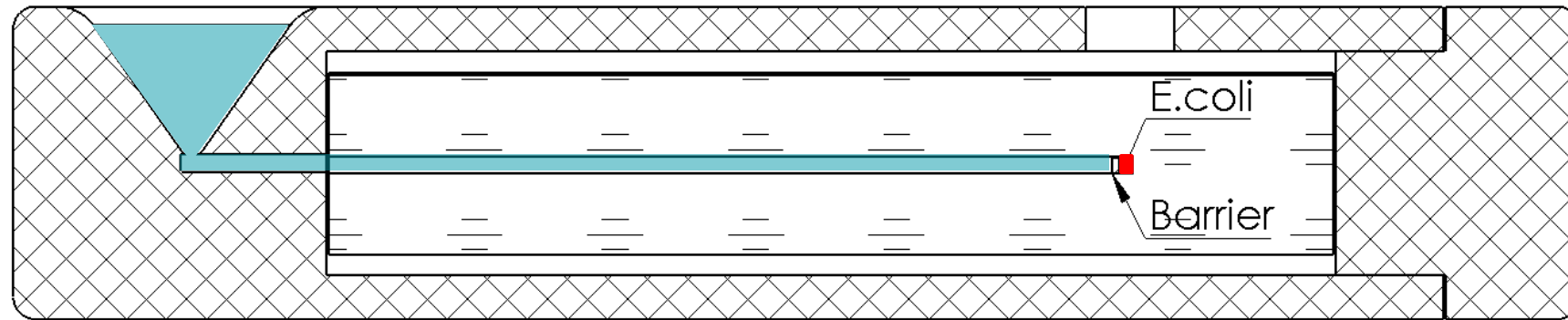
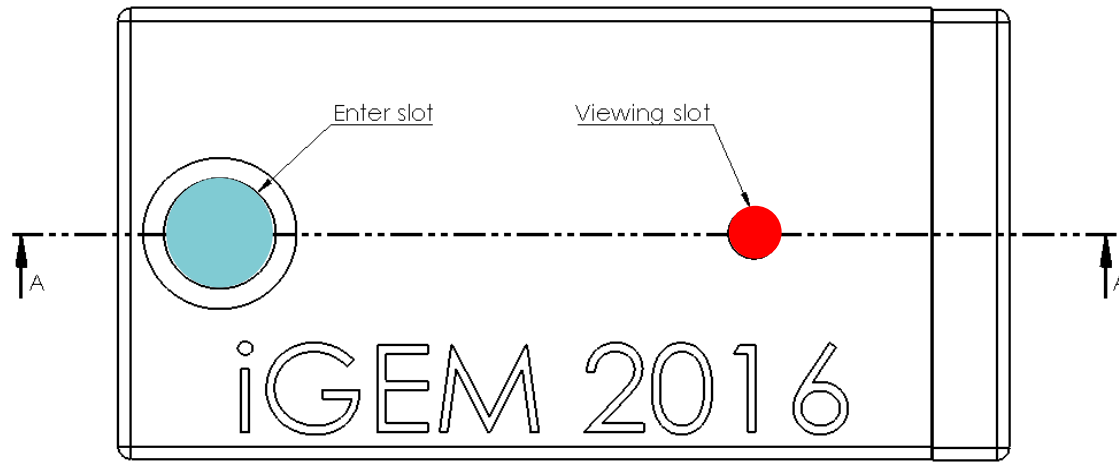
Movement towards attractant



Receptor for material B but  
without movement ability



# Prototype of our chip



SECTION A-A



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